

CLAIMS

We claim:

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1. A method of inhibiting the ability of a fast-spiking neuronal cell to discharge at a high rate, comprising: providing a compound capable of inhibiting Kv3.4 activity to a cell expressing Kv3 channels comprising a Kv3.4 subunit, under conditions such that the high rate of discharge is inhibited.

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2. The method of claim 1, wherein said compound is a toxin.

3. The method of claim 2, wherein said toxin comprises BDS-1.

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4. A method of manipulating neuronal ion channels, comprising: transfecting a fast-spiking neuronal cell with a vector encoding an siRNA directed against an mRNA encoding a Kv3.4 protein wherein said siRNA is capable of inhibiting Kv3.4 expression in said cell.

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5. The method of claim 4, wherein said cell is *in vivo*.

6. The method of claim 4, wherein said cell is *in vitro*.

7. The method of claim 4, wherein said cell is isolated *ex vivo*.

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8. The method of claim 4, wherein said cell is a neuronal stem cell.

9. The method of claim 4, wherein said cell is a globus pallidus neuron, a hippocampal interneuron, or a subthalamic neuron.

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10. The method of claim 7, further comprising the step of transplanting said cell into a subject.

5 11. A composition comprising an siRNA construct capable of inhibiting expression of a Kv3.4 subunit in a neuronal cell.

12. The composition of claim 11, wherein said Kv3.4 subunit is Kv3.4a subunit.

10 13. A method for screening for compounds that inhibit the activity of a Kv3.4 protein, comprising

- a) providing:
 - i) a cell expressing Kv3.4 protein, and
 - ii) a test compound; and
- b) detecting the activity of said Kv3.4 protein in the presence of said test compound.

15 14. The method of claim 13, wherein said test compound comprises a nucleic acid molecule.

20 15. The method of claim 13, wherein said test compound comprises an antibody directed against said Kv3.4 protein.

25 16. The method of claim 13, wherein said test compound comprises a small molecule drug.